AOSN MURI: Radio Communications for Labrador Sea AOSN 1998 Deployment

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LONG-TERM GOALS

Our intention is to create and demonstrate a reactive survey system, capable of long-term unattended deployments in harsh environments. We refer to such a system as an Autonomous Ocean Sampling Network (AOSN).

My goal is to employ bi-directional radio communications networks, satellite or short range, for automated data distribution and control between AOSN sampling systems and scientists' desktops.

OBJECTIVES

The objective of this component of the program was to develop the hardware and software for multiple methods of communications with the AUV docking controller on the AUV mooring deployed in the Labrador Sea in January 1998. A key requirement of the project was a 2-way satellite link for timely data retrieval and parameter control from shore. A necessary practical requirement was for a simple, reliable 2-way radio link between the deploying ship and both the communication controller (COMCON) in surface buoy and the docking controller (DOCCON) at 500m depth on the mooring.

APPROACH

Reliable communications with the AUV mooring system was required for reception of data and for AUV mission control from shore over the expected 3 month duration of the test. A short range radio link was essential to monitor events at the AUV dock, during deployment, docking tests and testing of the satellite communication link.

My approach was to provide a system housed within a surface buoy on the S-tether style deep mooring with sufficient intelligence to relieve the DOCCON of the direct control overhead of communications systems. A PC104 stack included CPU with standard I/O capabilities, custom timing and power control board (SPRAD), power converter boards and hard disk. Figure 1 shows the functions of the COMCON subsystem.

A simple transaction protocol was implemented to allow COMCON/DOCCON communication over a 2-conductor, galvanically isolated RS485 link as part of the electro-mechanical cable between the surface buoy and the DOCCON.

The Labrador Sea site was too distant for any practical method of communication to shore other than a satellite based system. The Inmarsat-C system had been selected and tested in October of 1997. While Inmarsat-C messaging is usually considered expensive to use and inappropriate for a battery powered system, in fact it can be competitive on both counts if controlled

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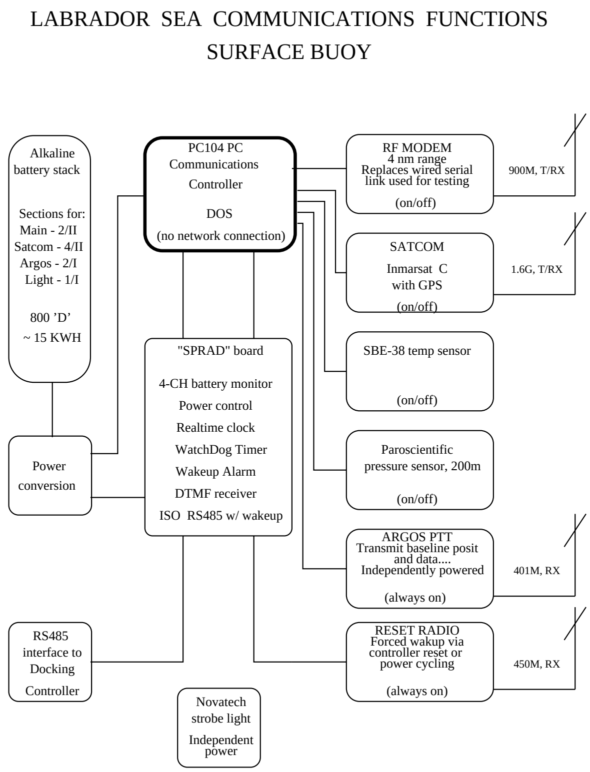

Figure 1: Labrador Sea AOSN Communications Controller Functions

properly, costing about $6.50 and between 1 and .5 Watt-hours per kilobyte of data transmitted.

WORK COMPLETED

A complete COMCON surface buoy was built and tested 1 year ago. A second system was assembled as a spare unit in preparation for the Labrador Sea cruise in January/February. Exhaustive testing of all communication capabilities was carried out including the isolated RS485 link between COMCON and DOCCON, radio modems, ARGOS, UHF reset link and Inmarsat-C link. Software development for the Inmarsat-C transceiver interface was completed. An email protocol was developed for messaging between shore and buoy. UNIX procmail scripts were written to automate the distribution of inbound data/status messages from buoy and synchronize the transmission of outbound messages to the buoy when it was known to be on-line.

RESULTS

The DOCCON was in communication with the shipboard console via the radio modem on the COMCON throughout the mooring deployment as a health check of the DOCK.

During the deployment period, 177 Inmarsat-C transmissions were attempted from the COMCON. Of these 171 were successfully received ashore. The COMCON transmited messages from the DOCCON via Inmarsat, normally every 2 hrs. In the absence of messages from the DOCCON, a default message of COMCON parameters was transmitted which included date, time, position, average and maximum pressure measurements, sea surface temperature and 4 battery voltages, (MAIN, SATCOM, STROBE and ARGOS). If one or more DOCCON messages were

available, the first was prepended with the default COMCON message. A subset of these transmit epochs was specified for receive attempts when the transceiver remained logged in to the Inmarsat system for 30 minutes to allow time for DOCK-bound messages to arrive from shore. Messages were always sent to at least 2 addresses, ithaca@whoi.edu and labsea@beluga@mit.edu.

Experimentation during COMCON development had shown that it usually takes about 2-3 minutes for a message to reach one's office as email from the time it was transmitted from the buoy. However it takes 18-20 minutes for an email message from shore to reach the buoy. Similar times were observed during the deployed period. Since the "retries" protocol used by Comsat, cannot guarantee delivery to a Mobil Earth Station when not continuously logged in, a workstation on the network at WHOI was configured to act as a "mail queuing node" for AOSN buoy messaging. Since it wasn't possible to guarantee the arrival of messages at COMCON when it was logged in to the Inmarsat system, mail for the buoy, (only from pre-selected email addresses), was sent to a ficitious user at the queuing node where it was packaged appropriately and held for forwarding to the buoy. At specified "receive" epochs, the buoy included as a recipient, the address of this fictitious user at the queuing node. Upon reception of mail from the buoy, this node immediately forwarded all queued mail to the buoy since it was then known to be logged in and available to receive messages.

Six transmission attempts from COMCON were unsuccessful. The symptoms, logged at the COMCON were either an inablity of the Inmarsat transceiver to log in, or once logged in, a failure to successfully transmit a message in the allotted time. Similarly, there were dock-bound message failures. We thnk that message failure was most likely a function of sea state, the low "look angle" to the satellite due to the high latitude of the BRAVO site (56N, 52W), and the proximity of the antenna to the sea surface.

IMPACT/APPLICATIONS

It is clear, despite the early termination of the Labrador Sea mooring deployment, that the COMCON instrument provided the planned levels of communication with the DOCCON. Inmarsat-C messaging was tested on a regular basis for the duration of the experiment with a growing confidence that it would have performed as expected despite the high latitude, proximity of the antenna to the water, and motion.

Emerging commercial satellite systems such as Iridium, may offer better choices for communication with open ocean systems compelling Inmarsat to be competitive. With a reduction in size of hardware and subscriber costs consistent with present technology, Inmarsat-C could be better utilized by the oceanographic community.

RELATED PROJECTS

This project is part of the Multidisciplinary University Research Initiative: "Real-Time Oceanography with Autonomous Ocean Sampling Networks: A Center for Excellence".

PUBLICATIONS

von der Heydt, K., Frye, D., Johnson, 1998: A Moored System for Data Telemetry and Control of Autonomous Underwater Vehicles, Submitted for MTS Ocean Community Conference, 11/98.